"On the Intensification & Reduction of Gelatine Negatives."

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(Read before the Ealing and the West London Photographic Societies.)

I SUPPOSE that every photographer in this room has at some time or other found it necessary to reduce or intensify his negatives, so as to make them printable; or, at any rate, so as to cause them to yield better prints, and the best means of bringing about the desired result in the best possible manner, has no doubt been with some of you a matter of difficulty.

And necessarily so, for intensifying and reducing even in the most experienced hands are far from being certain processes. They require a considerable amount of care and watchfulness to make them result as they should do; and even then there may be effects brought about which are different to what were intended.

As a rule these processes are looked upon as nuisances, especially amongst professionals, who have not much time to devote to them, and consequently the negatives requiring such treatment are put by until some time when they can be conveniently attended to. As soon as a lull in the general rush of business occurs, they are hurriedly despatched. In the case of mercury intensifying, the negative is first plunged into water for a few minutes and then into a solution of mercuric chloride, without having any regard to the perfect elimination of the hypo. When the surface looks sufficiently white the negative is slightly washed in water, and then immersed in a solution of ammonia until it is blackened all over. Then, after a few moments' washing, it is stood up to dry.

The result of such treatment most frequently is a yellow stain which nothing will remove; and so a negative is spoilt which might otherwise have been made to yield a good print.

If success is to be obtained in these processes it is only to be got by care and attention; haste is fatal to it.

I do not wish to imply that you are all guilty of such neglect, for I know there are some very careful photographers among you; but there is, nevertheless, a great deal of carelessness and trusting to chance with

many who should know better. It is to these I most especially address the remarks contained in this paper.

I do not presume to be able to teach you anything that is new or original, neither shall I introduce any fresh formula to your notice other than those that have appeared in the various photographic papers from time to time. I shall simply call to notice what is most required of an intensifier or reducer, and how far we can get it.

I have said how far we can get it; I ought rather have said how little we can get it, for it is remarkable in these processes, as in most photographic things, we generally require a great deal more than we are ever likely to get; therefore it is wise not to expect too much.

Yet, nevertheless, this desire for the unattainable is by no means to be condemned, for it frequently causes us to stretch forth an effort which we should not otherwise do were it not for this desire.

Every photographer, professional or amateur, should thoroughly understand the ins and outs of intensifying and reducing, as by their aid he has at his hand a means whereby he can give additional merit to his pictures, and can often save a negative which might otherwise be lost.

For instance, where a plate has been over-exposed it is very frequently a good plan to develop it until the detail is out, stopping development before it begins to fog; and making up its want of density by intensification. A better result is often obtained by so doing, if skilfully done, than if development had been continued in the usual way. Sometimes, however, you have not the chance to stop development before the plate fogs, and so you will say such a treatment is then impossible, but even here I have before now grappled with the difficulty by first reducing the negative with ozone bleach, which reduces the thickness of the film, and then intensifying it again with mercury—the result being a more brilliant negative owing to the fact that the chief of the half-tone or the fog lies on the surface of the film, whereas the denser parts penetrate to a greater depth; the bleach taking off the upper surface of the film, and the half-tone upon it leaves the darker portions to be strengthened by the intensifier.

Another plan of mine has been to varnish the negative all over except where the strong parts have been, as in the case of interiors, and then to reduce the dense portions with some suitable reducer, so as to neutralise the contrast. This can be very effectually brought about where a window is too dense and the surroundings are in deep shadow. The varnish is applied very carefully with a brush; and the reduction effected with potash-ferridcyanide. By this method I have even gone so far as to take out the background from a portrait negative, leaving the head upon a clear glass; but it requires very carefully doing.

Now before we go on to formulæ it is best that we should know what is the most that is required of an intensifier and a reducer.

An ideal intensifier should fulfil these requirements:—(1) It should intensify the high lights more in proportion to the half-tones, such as

would be necessary in an over-exposed plate, where there is plenty of detail, but not enough density ; (2) it should intensify the half-tones more in proportion to the high lights, as in the case of a negative slightly under-exposed, where the high lights are about the right density, but the half-tone is weak ; (3) it should intensify all parts in equal proportion as in the case of a negative which is too weak generally. These same remarks apply with equal weight to the ideal reducer. The ideal reducer should act in such a manner that :—(1) It should attack the high lights more in proportion to the half-tones as when a negative is under-exposed and the high lights are consequently too strong. This would be greatly assisted when an intensifier strengthens the half-tones more than the lights ; and the two could be used consecutively ; (2) it should reduce the half-tones more in proportion to the high lights, so that an over-exposed negative could be thinned down in its half-tones to give the high lights more value · (3) it should reduce the negative in equal proportions generally, so that a negative which is so thick that printing takes too long, can be thinned down generally, and printing be thus facilitated.

The permanency of the negative should not in any way be affected by the treatment.

With regard to the permanency of negatives after treatment with any of the known reducing formula, I believe they are not affected in any way whatever, and that a negative which has been carefully reduced and proper attention given to the washing will stand as long as if it had not been reduced. But this, unfortunately, cannot be said about all the intensifiers at present in use. The experience of many of you will no doubt bring to mind the fading of many a valuable negative, which had been strengthened by intensification.

Yet, here again I believe the fault has been due more to insufficient care in washing than to the shortcomings of the intensifier.

As for the relative value of an intensified negative, Captain Abney has proved, I believe, beyond a doubt, that the half-tones are strengthened more in proportion to the high lights ; and therefore there is generally less detail in the higher lights of an intensified negative than in the same negative before the treatment. I myself have often noticed the want of detail, which an intensified negative gives in the resulting print in the high lights, to what had appeared in the same negative before strengthening.

It should be said, however, that I had used the same formula as Abney had used. The same rule may not be applicable to other formula.

Before reducing, and especially before intensifying, the plate must be entirely freed from all traces of the fixing agent. Want of attention to this rule is almost the only cause of stains, and is also a great cause of fading. To free the plate from hypo. nothing is better than placing it in a solution of hydrogen peroxide.

The method of using it is as follows :—The plate is first washed under the tap, and then placed in the following solution :—

Hydrogen peroxide	½ drm.
Water	2½ oz.

In this it remains for a few minutes, and is again washed, so as to free it from the peroxide. The plate can then be intensified or reduced in the usual way.

Another way of clearing the plate from hypo. is also stated to be very effectual.

An ounce of glacial acetic acid is added to four ounces of water. To this is added, little by little, one ounce of barium dioxide finely powdered. When this is dissolved the plate is soaked in it for a few minutes and then slightly washed. For the efficiency of this method I am unable to express any opinion as I have not yet tried it, though, as far as I can see, there is no reason why it should not be as good as the peroxide of hydrogen, which chemical forms part of its composition; and it is no doubt cheaper.

Personally I use nothing but a saturated solution of alum for ridding negatives from hypo., giving each negative half an hour's washing in several changes of water, and then placing it in the alum for about twenty minutes, afterwards letting the plate remain in running water for about ten minutes.

Whilst I was writing these lines I noticed in the *Photographic Review*, that, " according to Dr. Stolze, the alum bath should not be used until the fixing solution has been removed by washing ; otherwise sulphur may be deposited in the film, and will cause fading."

Certainly I am aware that hyposulphite of sodium and alum decompose one another ; but as far as my own experience goes, I have never found any bad results to come from the method last described.

There is one more point I should like to mention. There seems to be a difference of opinion existing, as regards the best time to intensify a negative ; some saying it is best to let the plate dry first, whilst others prefer to treat it before the film has lost its first moisture.

As to the best time to intensify : if a negative partly dry and partly wet is used, where the film is wet it becomes denser than where it is dry. Therefore, to take advantage of this difference it is best to let the plate dry, if it is not required to strengthen it to the fullest extent ; and to treat it before it becomes dry, when the greatest intensity is required. The cause of this is owing to the difference in the porosity of the gelatine film before and after drying.

When a plate has been exposed and developed, it contains a certain amount of unreduced silver bromide surrounded with gelatine, which is dissolved out from the gelatine by the fixing agent. When this is fixed out, it being a solid substance, it naturally leaves a number of pores

which finally become filled with water. When the plate is placed in the intensifying solution these pores rapidly become filled with it, by exosmose action.

For this reason the intensifier has greater action on the silver than if the plate was dried first, because the water evaporating out of the film allows the pores to become closed up, and as they do not open again to such an extent on being placed into water the second time, the gelatine acts to a certain degree as a barrier to the action of the intensifier.

Having made these preliminary remarks, I will now proceed to describe the various methods employed for increasing or reducing the printing density of a plate ; and as there is less to say about the latter than the former, I will treat upon that subject first.

Reduction of density can be effected in two principal ways ; the film can be reduced in thickness by mechanical means, or by solution, or the silver forming the image can be changed into some substance which can be dissolved by a solvent.

For reducing by the first of these methods, Mr. Debenham recommended the use of ozone bleach.

After the plate has been immersed in a solution of chrome alum, about one ounce to the pint, it is placed in a solution of ozone bleach of the strength of about one to six of water.

Holme's ozone bleach is a substance which is used by laundresses for bleaching purposes, and can be obtained either at the oil shops, or at several of the photographic chemists, and is very cheap. In the place of ozone bleach, a saturated solution of chloride of lime can be used in the same manner ; but a substance which I like better than either of these is hypochlorite of potash, otherwise known as "Eau de Javelle."

To prepare this, dissolve one ounce of chloride of lime in fifteen ounces of water, and two ounces of carbonate of potash in five ounces of water. These are mixed, boiled, and filtered, and when cold, are diluted, one of the solution to five of water being the strength I most generally use.

All these methods act very much in the same manner, viz. : by dissolving the upper part of the film away. If reduction is to be carried to a great extent, the plate is placed in hypo., which dissolves out the silver that has been converted to the chloride.

To reduce locally, a stronger solution is poured on the parts to be thinned the most, and if necessary these parts can be rubbed with the finger, or better still with a piece of cotton wool until the required reduction is produced.

Great care must be exercised in using these solutions. Do not handle the plate more than can be helped, or frilling may result ; keep the plate gently rocking, or the reduction will not be even ; do not rock too violently, or the edges of the film will be eaten away ; do not have

the solution too strong, or blisters will occur ; and, finally, let the tap be *gently* running, so that the solution can be thrown off, and the plate be *immediately* washed without draining, or streaks and honeycomb markings will show themselves all over the plate.

Local reduction can very well be brought about by rubbing the parts to be reduced with a piece of wool dipped in strong alcohol, and if carefully done the result is very good. I have also heard of an operator who used to reduce locally with a mixture of very fine emery powder and some greasy material, such as lard, applied to the parts with a leather stump ; but only very small places can be properly reduced by this means for obvious reasons. The grease is removed by a piece of rag dipped in turpentine.

The chemical method of reducing is done either with ferric chloride or potassium ferridcyanide.

For the first of these make a solution of ferric chloride, one drachm to six ounces of water. The plate on being immersed in this has some of its silver converted to silver chloride, which is dissolved out with hypo.

The method with potassium ferridcyanide, which was, I believe, introduced by the Polytechnic School of Photography, and which I prefer to all others, is as follows :—

A solution of red prussiate of potash (potassium ferridcyanide) is prepared. Some hyposulphite fixing solution is taken, and the prussiate added to it until it assumes a bright yellow colour. The plate is simply taken from the fixing bath, and transferred direct to this, where it is kept, gently rocking, until reduction is complete. The beauty of this reducer is, no washing is required after fixing, and, also, you can be certain to what extent the reduction will go. If the plate is to be reduced locally it should be dried first, if the parts have a sharp outline. The solution can then be applied with a camel's hair brush, or, as before stated, the negative can be varnished all over, except in the parts to be reduced, and the plate immersed in the solution until thinned down enough.

The chemical change which takes place with this reducer is, the silver, directly it is touched by the potassium ferridcyanide, is decomposed, and forms silver ferrocyanide and potassium ferrocyanide, and the silver ferrocyanide is dissolved out by the hypo. One word more. As the ferridcyanide solution will not keep when mixed with hypo, it must be made up a little while before using ; and, further, if reduction is to be carried to a great extent, the solution should be rendered highly alkaline with ammonia, to prevent the negative turning yellow.

So much then for reducing. I will now proceed to treat upon the process of intensifying.

There are three methods, so to speak, of strengthening the negative image, viz.—(1) The physical method, depending upon the crystalline attraction of silver in solution to deposit upon the silver forming the

image; (2) the chemical method, depending upon the reducing power of silver to reduce a metallic salt which is soluble to a sub-salt, which sub-salt is insoluble, and is thus deposited upon the image, or else, by acting again upon another substance, produces an extra deposit; (3) by strengthening the image by adding a dark material to the back of the negative over those portions which require strengthening.

Under the first method comes Captain Abney's formula for silver intensification. It is as follows :—

SOLUTION No. 1.

Pyrogallic acid	2 grs.
Citric acid	2 to 4 ,,
Water	1 oz.

SOLUTION No. 2.

Iron sulphate	5 grs.
Citric acid	10 ,,
Water	1 oz.

Either of these solutions are taken, and a few drops of a 10-grain (to the ounce of water) solution of nitrate silver is added just before using. It is then flowed over the plate. When the plate is sufficiently intensified it is washed and placed in a solution of common sodium chloride, and after again fixing for a few minutes in hypo., it is thoroughly washed.

Any stains which may happen to appear may be removed with a five-grain solution of potassium cyanide.

Although this is theoretically the best form of intensifier, it cannot be recommended, owing to its liability to produce stains, especially if there should be any trace of hypo. in the film.

Another method of intensification, which is known as the Polytechnic method, and which, I believe, was introduced by Mr. E. Howard Farmer, is one of the best of its class that was ever invented. The intensified negative cannot be recognised from one which had been properly strengthened in development; and its best recommendation is, it does not require any washing to free it from the hypo. The following solutions are required :—

SOLUTION No. 1.

Silver nitrate	1 oz.
Distilled water	12 ,,

SOLUTION No. 2.

Potassium bromide	¾ oz.
Water	2 ,,

SOLUTION No. 3.

Hypo.	2 oz.
Water	6 ,,

No. 1 is added to No. 2; this, of course, produces a precipitate of silver bromide, which must be washed two or three times in clear water, and the water drained off. It is then dissolved by agitating it in No. 3. A muddy solution is thus produced which must be filtered. The solution is made up to 16 ounces, and can then be bottled for use.

To intensify a plate with this solution, it is first rinsed under the tap for a minute or so after removing from the fixing bath, and is then placed in the following :—

Pyro. (preserved in sulphite)	4 grs.
Water	2 oz.
Silver solution as above	1 drm.

to which has been added about half a drachm of ammonia diluted to about one of ammonia to eight of water. When density has been obtained it is again rinsed and placed in the fixing bath to clear it. It is then finally washed.

Should the silver not show any tendency to reduce, that is, should the plate not intensify as quickly as it ought, the solution requires more ammonia; but if, on the other hand, a brown precipitate is rapidly thrown down, it shows the presence of too much ammonia.

If considerable density is required it is necessary to throw off the solution, as soon as it becomes muddy, and after rinsing to apply fresh. It is hardly necessary to add that the plate must be rocked all the time intensification is proceeding, otherwise it will become patchy.

Another way to use this intensifier is to place the plate in the silver solution for about five or six minutes, and after letting it drain to flood it with an ordinary oxalate developer, when the silver will be reduced. If only a slight increase of density is wanted, then the silver solution is diluted, more or less, according to the amount of density required, with ordinary water.

Of this intensifier I can speak in the highest terms, as being one which can be depended upon, and, although appearing from a mere verbal description somewhat complicated, as being an extremely easy one to work with in actual practice.

Before I leave this portion of my paper there is just one more formula I should like to bring before those who might care to experiment in this direction. It sounds to be a very good one, but I cannot say what its qualities are, as I have not tried it. It was published in the *Photographic Review*, of December 14th, 1889, and is known as Kassebaum's Intensifier. I repeat word for word from that journal.

" The plate is soaked for some minutes in a solution of citric acid say one part in twenty of water, after which the following is poured on :—

A.

" Hydroquinone	6 grms. (about 92 grains).
Water ...	700 cubic cents. (about 24½ fld. drms).
Nitric acid	10 drops.

B.

Silver nitrate	8 grammes (about 123 grs).
Water ...	100 grammes (about 3½ fluid ounces).

" Forty volumes of A are mixed with one of B. The action of this intensifier is slow, but very satisfactory. A second fixing is desirable, so as to remove all traces of undecomposed nitrate."

We have now to consider the second class of intensifiers, which are those whose action is due to chemical change, and which contain the forms of intensifiers most in use, namely, the mercuric intensifiers ; but, before I go on to them there are two which I should like to mention, chiefly on account of the novelty of the colour they render the negative.

The first of these is Mr. Selle's method with uranium nitrate.

The formula is as follows :—

Uranium nitrate	2 drms.
Potassium ferridcyanide	2 ,,
Water	½ pint.

This must be filtered.

The plate after being well washed is placed in this solution, which acts by turning the film red, at the same time strengthening the strong portions to a very great degree.

This is a very good intensifier if very great density is required, but you must be certain there is not the slightest trace of hypo. in the film, otherwise a precipitate will settle itself all over the film. The chemical change which takes place in this case, is ; the silver which constitutes the image reduces the potassium ferridcyanide to ferrous cyanide, which, combining with the uranium, forms an insoluble double cyanide, which is precipitated on the image. Hypo. also converts the ferric to the ferrous salt, so if hypo. is present in the film a precipitate is deposited all over the negative.

Mr. Carey Lea's is the other method which gives a bright red negative. This is as follows :—The plate is first immersed in a sherry-coloured solution of iodine, until it has changed its silver to silver iodine ; it is then placed in a solution of

Schlippe's salts	½ oz.
Water	1 pint.

which converts it to a bright red colour.

Schlippe's salt is a double sulphide of sodium and antimony. The silver iodide combines with this, and forms a double sulphide of silver and antimony ; the sodium which was displaced by the silver combining with the iodine, and forming sodium iodide. If a very dense negative is required, the plate is left in the iodine until all the silver is converted to iodide.

This solution of Schlippe's salts does not keep, therefore it must be made up as required.

Of the mercury intensifiers there are many formulæ, although very few operators seem to act in strict accordance with them.

Perhaps the simplest is that known as Dr. Eder's formula.

For this the following solutions are required :—

No. 1.

Mercuric chloride	¼ oz.
Water	1 pint.

No. 2.

Ammonia (·880) ...	2 oz.
Water ...	1 pint.

No. 3.

Potassium iodide...	1 oz.
Water ...	1 pint.

To intensify with this, the plate must first be placed in No. 1 until the mercury has whitened it, in most cases, right through.

Then the plate is washed for a short time, after which it is placed in the ammonia solution till it is blackened through to the back of the plate, and it is then finally washed. If, however, a greater amount of density is required than this gives, the plate must be placed in the iodide solution. This is done after the plate has been treated with the mercury and washed, and before treating with the ammonia, and the plate must be washed after the application of the iodide.

After this treatment it is sometimes found to be too dense. If such is the case it can again be reduced by placing it in a solution of hypo. of about half-an-ounce to the pint.

Dr. Eder is also, I believe, the author of the following formula, which is, perhaps, an improvement upon the last.

After the negative has been bleached with the mercury it is thoroughly washed and treated with this solution :—

Potassium cyanide ...	10 parts.
Potassium iodide ...	5 ,,
Mercuric chloride ...	5 ,,
Water ...	2,000 ,,

This causes the film to become a dark brown ; and if it should give too great a density it need only be left in this solution for a little longer, when it will gradually reduce again.

This is certainly very simple, but it is evident, as the solution reduces after the maximum density is obtained, the negative under treatment must be closely watched.

A slightly different kind of mercuric iodide intensifier is that recommended by Mr. Edwards. Three solutlons are made up as follows :—

No. 1.

Mercuric chloride ...	60 grs.
Water ...	1 oz.

No. 2.

Potassium iodide ...	90 grs.
Water ...	2 oz.

These two solutions are added when mercuric iodide is formed as a red precipitate. To this another solution is added, consisting of—

Hypo. ...	120 grs.
Water ...	2 oz.

which dissolves the precipitate. The plate is merely placed in this until density is obtained, which takes place very quickly. For this

reason I prefer to use more hypo. than here given, as the strengthening action takes place more slowly, and the plate is thus more under command.

This is a very simple intensifier to use, and has, moreover, the advantage that the plate need not be very thoroughly washed after being fixed ; but in my hands it has not been very successful, as I have never been able to prevent it clogging up the shadows.

About the best intensifier for general use, wherein mercury is employed, is the one which Captain Abney has recommended some time back, and which, I think, is a slight modification of Dr. Monckhoven's method. The following are the solutions required :—

SOLUTION No. 1.

Mercuric chloride	100 grs.
Potassium bromide	100 ,,
Water	10 oz.

SOLUTION No. 2.

Silver Nitrate	100 grs.
Water	10 oz.

To this last is added a solution of potassium cyanide, which produces a precipitate. The cyanide must be added gradually, little by little, and with agitation. After a time the precipitate will re-dissolve, and the cyanide must be added until only a very little of it is left undissolved. The strength of the cyanide recommended by Captain Abney is 100 grains to the ounce of water. After the plate has been thoroughly freed from the fixing agent it is bleached in the mercury solution ; and, after washing, is placed in the silver solution until it is blackened right through.

Captain Abney says this is the best and most permanent intensifier he has ever used, and considers it to supersede all others. Certainly if a clear and vigorous negative is required, it is without doubt a splendid one to use. However, where permanency is the principal consideration, all mercuric intensifiers should be used with caution, as compounds in which mercury forms a part are looked upon by most experimenters as unstable substances. I will now go on to describe a method of treating negatives that require strengthening, which I have used very successfully indeed for a long time, and one which is a good advance towards the ideal. This method is not entirely my own ; it was to a great extent published in one of the photographic papers a long time past ; but as it does not seem to have attracted the attention of many photographers it will, no doubt, be new to some of you.

It is tolerably well known that if a negative is first whitened with mercuric chloride and then blackened with ammonia, the density is considerably greater than if it had been blackened with sodic sulphite. Now, as ammonia and sodic sulphite can be used at the same time, or one after the other upon a plate, without any harm coming to it, I take advantage of the different strengthening power of the two chemicals in the following manner :—

Supposing I have a negative which I desire to strengthen more in the half-tones than I do in high lights I proceed as follows:

The plate is laid, face downwards, in a dish, the ends being supported on a couple of pieces of match, so that the face of the plate does not touch the bottom of the dish. The mercuric chloride is then poured in and allowed to cover the plate. The plate must now be watched closely, and as soon as it is whitened through—*until all but the highest lights are changed*—it must be taken out and immediately washed

When sufficiently washed it is placed face downwards, as before, in a rather weak solution of ammonia until the half-tones *only* have blackened through, when it is again placed under the tap for a few seconds just to stop the action of the ammonia going any further. After this has been done it is finished by placing it in a solution of sodic sulphite of about a quarter the strength of a saturated solution until the high lights are black right through. It is then washed as usual.

It will be obvious to all of you that this method gives to the half-tones a greater proportion of strength than it does to the high lights—especially if the bleaching process has not proceeded too far. This method is equally applicable to a negative which requires a greater proportion of strength in the high lights, as in the case of an over-exposed plate.

The negative is bleached entirely through, *including the highest lights*. Then, after washing, it is placed in a solution of sodic sulphite until the half-tones *only* are blackened through, after which it is finally immersed in a rather strong ammonia solution until the blackening is complete. Thus it will be seen that not only can either the high lights or the half-tones be strengthened as required, but by varying the length of time of immersion in either solution, and by varying the amount of bleaching, almost any result can be obtained.

As I have already taken up very much of your time, I must draw my paper to a close without speaking of the chemical changes which take place in all these operations, as I intended to do.

Neither can I speak on the third method of strengthening negatives, viz., the powder process, although much use can be made of this process in the artistic treatment of negatives, but must content myself with the hope that some of you may have learnt something from what I have already said, or that fresh ideas may present themselves to you through hearing me; and the hope that I may cause you to make more use of these ways of improving the artistic merits of your pictures must be my apology for having brought this subject before you.